Tying lipstick smears from crime scenes to specific brands

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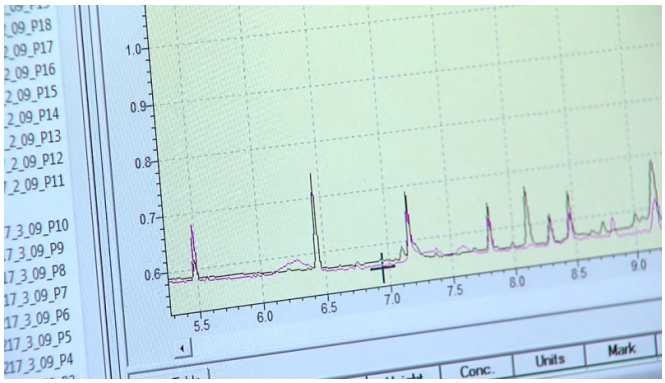

It's a common forensic TV show trope: A crime is committed, there are no suspects, and then detectives find a faint lipstick mark. The sample is put in an evidence bag and sent to the lab. Then boom, they analyze it in minutes and get a lead. In real life, forensic analyses are not nearly as fast or straightforward. But scientists now report progress on the technical front. They have developed an improved method for lifting lipstick samples from surfaces and have found that gas chromatography is an ideal way to analyze them.

The researchers present their work today at the 251st National Meeting & Exposition of the American Chemical Society (ACS). ACS, the world's largest scientific society, is holding the meeting here through Thursday.

"Working on this investigation has opened my eyes to the fact that TV has it wrong—things take much longer in real life," says Bethany Esterlen, an undergraduate student and lead researcher working on the project in the lab of Brian Bellott, Ph.D.

For years, forensic scientists have applied various methods to remove lipstick samples from crime scenes and analyze their chemical constituents. Many current methods involve difficult or expensive steps such as a tedious lipstick removal process or examination of samples by Raman spectroscopy or X-ray diffraction. But these methods require specialized equipment and training, which are in short supply in under-funded and over-worked forensics labs.

So Bellott, Esterlen and colleagues at Western Illinois University decided to develop a better way to lift these samples and further analyze them. They began with an established method of lipstick sample extraction, but then eliminated unnecessary steps and improved upon the rest. The final method is a two-part process: First they add an organic solvent to remove most of the oils and waxes, and then they add a basic organic solvent to extract the remaining residue.

"Right now we are just lifting samples off of paper, but in the future we are hoping to use different articles and media that could be found at a crime scene," says Bellott.

Armed with a short, robust way to lift lipstick, Bellott's team turned to determining a quick, efficient method for analyzing the cosmetic. To avoid methods that involve complex training, the team investigated three types of chromatography: thin layer chromatography (TLC), gas chromatography (GC) and high performance liquid chromatography (HPLC). GC and HPLC methods both rely on injecting a sample into a machine and reading the results on a computer, whereas TLC involves researchers looking at samples on a special type of surface under ultraviolet light.

The team chose 40 lipsticks and made marks with them on paper to simulate finding smears at the scene of a crime. Different brands of lipsticks have unique compositions of organic molecules, which give distinct chromatography signals. Then

researchers can compare spectra of crime scene lipstick to those of known lipsticks, which are compiled in a database, or "library." Once the brand is identified, law enforcement officials could investigate whether a suspect uses that particular cosmetic.

The team is still performing the analyses, but at this stage they see the best results with the GC technique.

Bellott says this overall method, from sample gathering to analysis, can be adopted by forensic labs as-is. However, the team is working on making it even better by continuing to build their extensive lipstick library and looking for ways to make it easier and more robust.

More information: Forensic Analysis of Lipstick Samples by Three Different Analytical Techniques, the 251st National Meeting & Exposition of the American Chemical Society (ACS), 2016.

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